

# STUDY OF THE PHYSICS OF NEUTRINOS

(Boris Kayser; presented by Doug Michael)

Sponsored by the American Physical Society Divisions of —

- ◆ Particles and Fields
- ◆ Nuclear Physics
- ◆ Astrophysics
- ◆ Physics of Beams

Organizational meeting was held December 2003.

[www.neutrinooscillation.org/studyaps/](http://www.neutrinooscillation.org/studyaps/)

Final results will be distributed August 2004.

Our blessing —

Compelling evidence for neutrino mass and mixing.

Our opportunity —

To answer the neutrino questions raised by this discovery.

Our purpose —

To ensure that we make the best possible use of this opportunity.

# Some of the Open Questions

- What physics is responsible for neutrino masses and mixing?
- How many neutrino species are there?  
Are there sterile neutrinos?
- What is the neutrino mass spectral pattern?
- What is the scale of neutrino mass?
- Are neutrinos Majorana particles ( $\bar{\nu} = \nu$ )?
- What is the leptonic mixing matrix?
- Do neutrino interactions violate CP?
- Is leptonic  $\mathcal{CP}$  responsible for the baryon asymmetry in the universe?

- Are there surprises?
  - Rapid  $\mu$  decay?
  - Non-Standard-Model  $\mu$  interactions?
  - Towers of sterile neutrinos from extra dimensions?
  - ???

# The Purposes of the Study

— Primary Purpose —

To move towards a coherent strategy for answering the open neutrino questions — a clear, unified plan that funding sources can easily consider and promote.

To this end, we will—

- Identify the most important questions
- Evaluate the physics reach of the proposed ways of answering them
- Examine how different facilities and experiments complement each other
- Create a decision tree
- Determine an intelligent sequence of facilities and experiments

— Secondary Purpose —

To explain to our colleagues in other areas of physics, our funding sources, and the general public why neutrino physics is now so exciting.

While the Study was initiated by the American Physical Society, the strategy for future neutrino physics must be a **global** strategy.

Participation in the Study by physicists throughout the world is very warmly encouraged.

# The Structure of the Study

## Chairmen

Stuart Freedman, Boris Kayser

## Organizing Committee

Janet Conrad, Guido Drexlin,  
Belen Gavela, Takaaki Kajita,  
Paul Langacker, Keith Olive,  
Bob Palmer, Georg Raffelt,  
Hamish Robertson, Stan Wojcicki  
Lincoln Wolfenstein

# Working Groups — The Central Element

Each working group is defined by an experimental approach.

The groups, their leaders, and their first meeting —

## Solar and Atmospheric Neutrino Experiments

John Bahcall <jnb@ias.edu>, Josh Klein <jrk@physics.utexas.edu>

January 19, by phone

## Reactor Neutrino Experiments

Gabriela Barenboim <gabriela@fnal.gov>, Ed Blucher <blucher@hep.uchicago.edu>

February 7-8, Chicago

## Superbeam Experiments and Development

Bill Marciano <marciano@bnl.gov>, Doug Michael <michael@hep.caltech.edu>

January 29-30, Fermilab

## Neutrino Factory and Beta Beam Experiments and Development

Stephen Geer <sgeer@fnal.gov>, Michael Zisman <mszisman@lbl.gov>

TBA

## Neutrinoless Double Beta Decay and Direct Searches for Neutrino Mass

Steve Elliott <elliotts@lanl.gov>, Petr Vogel <pxv@caltech.edu>

February 27-28, Caltech

## What Cosmology/Astrophysics and Neutrino Physics can Teach Each Other

Steve Barwick <barwick@HEP.ps.uci.edu>, John Beacom <beacom@fnal.gov>

TBA

Theorists participate in all working groups.

They will also discuss issues like how best to use future measurements to discriminate among theoretical models.

Coordinator of theoretical discussions:

Rabi Mohapatra <[rmohapat@physics.umd.edu](mailto:rmohapat@physics.umd.edu)>

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To join a working group, please contact its leaders.

# Conveying the Excitement

The importance of our secondary purpose —  
**conveying the excitement in neutrino physics** —  
has been made apparent by recent statements by  
government representatives.

We will —

- Devote part of our final report to this
- Organize a Neutrino-Fest, with media presence

Neutrino experts who are especially good at writing  
for, or speaking to, the broader community are  
being sought.

**INTERESTED PHYSICISTS FROM  
THROUGHOUT THE WORLD PHYSICS  
COMMUNITY ARE VERY WELCOME!**

**PLEASE JOIN OUR STUDY!**

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